

ART. VIII.—*Victorian Graptolites (New Series), Part I.*

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(Plates VII. and VIII.)

[Read 8th November, 1923.]

The first descriptions and figures of Victorian graptolites date back to 1874, when Sir F. McCoy¹ included several species, both Upper and Lower Ordovician, in his *Prodromus of the Palæontology of Victoria*. In the same year, R. Etheridge, Junr.² also published a paper with some good figures. Then, after many years, Mr. (afterwards Dr. G. B. Pritchard³ dealt with some Lancefieldian forms, and Dr. T. S. Hall began the work which he was to pursue for over twenty years, and which entitled him to rank as one of the foremost authorities on Australian graptolites. Apart from incidental descriptions when dealing with collections—many such descriptions being included in the publications of the Geological Surveys of Victoria and New South Wales—Dr. Hall published a series of papers on Victorian graptolites. In Part I.⁴, Dr. Hall dealt with Upper Ordovician graptolites of Matlock, and a new species of *Dictyonema*; Part II.⁵, 1898, is concerned with the Lancefieldian series; Part III.⁶, 1905, describes the Mount Wellington (Upper Ordovician) graptolites, while Part IV.⁷, 1914, describes and figures some new or little-known species. Other descriptions, on a smaller scale, the work of R. A. Keble, have been published by the Geological Survey of Victoria. Mr. Keble, in collaboration with the writer, also figured some new Lower Ordovician forms in a paper read before this Society.⁸

The adoption of Dr. Hall's serial name for this article may appear unauthorised, but any other title would probably duplicate, or closely approximate to, the titles of some of Dr. Hall's numerous papers on the subject. The beginning of a new series should prevent confusion.

The first section of the present paper deals with some Lower Ordovician forms from the Castlemaine district, mentioned in an earlier article and there figured⁹ but not described. With them is

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- 1.—McCoy, F., *Prod. Pal., Vict.*, 1874, Dec. 1, et seq.
 - 2.—Etheridge, R., Junr., *Ann. Mag. Nat. Hist.*, 1874, sec. 4, vol. 14.
 - 3.—Pritchard, G. B., *Proc. Roy. Soc. Vict. (n.s.)*, 1894, vol. vi.; 1895, vol. vii.
 - 4.—Hall, T. S., *Proc. Roy. Soc. Vict. (n.s.)*, 1897, vol. x.
 - 5.—*Ibid.*, 1899, vol. xi., part 2.
 - 6.—*Ibid.*, 1905, vol. xviii., part 1.
 - 7.—*Ibid.*, 1914, vol. xxvii., part ?
 - 8.—Harris, W. J., and Keble, R. A., *Proc. Roy. Soc. Vict.*, 1916, vol. xxix. (n.s.), part 1, pl. 1.

here included an important zonal graptolite mentioned in the same article but not further treated there. This portion of the paper represents some of the material intended for the second part of the work on the Castlemaine Rocks—a work suspended by the author's removal from the district. Section A therefore contains descriptions of:

- Didymograptus v-deflexus*, sp. nov.
Cardiograptus, Harris and Keble.
Cardiograptus morsus, H. and K.
Oncograptus biangulatus, H. and K.
Diplograptus gnomonicus, H. and K.

It also includes a note on *Trigonograptus ensiformis*, and description and figures of *Lasiograptus etheridgei*, sp. nov., previously figured by Etheridge² as *Diplograptus mucronatus*.

The second section of the paper deals with some Upper Ordovician graptolites from an outcrop at the junction of Riddell's and Jackson's Creeks in the Gisborne district. Descriptions and figures are given of:

- Retiograptus speciosus*, sp. nov.
Climacograptus riddellensis, sp. nov.
 (previously recorded by McCoy¹ as *Diplograptus rectangularis*.)
Glossograptus hincksi, Hopkinson sp.
 (previously recorded by McCoy¹ as *D. mucronatus*.)
Didymograptus caduceus, Salter.
Cryptograptus tricornis, Carruthers.

while a note on *Thamnograptus capillaris* is also appended.

I am indebted to Mr. F. Chapman, A.L.S. of the National Museum, Melbourne, for valuable advice during the preparation of this paper."

Didymograptus v-deflexus, nov. sp.

(Plate VII., figs., 1, 2.)

(Nomen nudum, Harris, W. J., Proc. Roy. Socy. Vict., 1916, Vol. XXIX., n.s., p. 11., p. 55., 60 ct. seq.)

Description.—Sicula fairly broad, about 1.1mm. in length. Stipes deflexed, originating sub-orally at an angle of 120°. The angle between the stipes soon diminishes to 90-95°, but then increases until ultimately it becomes 150° or more, in lengthy specimens, 180°. The changes in the angles between the stipes gives the specimens their characteristic outline. Thecae, 9 to 11 in 10mm., inclined at 30°, three or four times as long as wide, ventral margins of proximal thecae concave, but of distal thecae straight. Apertural margins slightly concave and inclined at an angle of 110° to the axis of the stipe. The thecae overlap each other by about one half. The closer arrangement of the thecae is perhaps the

more common. Width over first theca, about .7mm., increasing gradually to slightly more than 1mm., and then remaining constant.

Remarks.—In so much as this graptolite belongs to the small group of deflexed *Didymograpti*, it resembles, in external form, *D. v-fractus*, Salter, and *D. deflexus*, E. and W. Its resemblance to these forms is only superficial, and probably the most closely related form is *D. uniformis*, E. and W., which precedes it in the Castlemaine beds and is found with it in the Darriwil series. From *D. uniformis*, it may be distinguished by the greater initial angle of divergence of the stipes and by their later convergence and ultimate separation. In other words, *D. uniformis* belongs not to the deflexed, but to the horizontal series. Occasionally forms of *D. v-deflexus* are found in which the characteristic curves are so poorly shown that confusion may be possible between them and specimens of *D. uniformis*.

The following table shows the characteristics of the species mentioned:

Form	<i>D. deflexus</i> Deflexed	<i>D. v-fractus</i> Deflexed	<i>D. uniformis</i> Horizontal with marked proximal curvature.	<i>D. v-deflexus</i> Deflexed
Thecae in 10 mm.	14	8-10	11	9-11
Inclination	25-30°	35-55°	30°	30°
Divergence		90-10-130°	To 180°	120-90-150°
Overlap			$\frac{1}{2}$ to $\frac{2}{3}$	$\frac{1}{2}$

Didymograptus v-deflexus is a characteristic fossil of the Darriwil series, being found at most outcrops of the series in the Castlemaine and Gisborne districts. Some of the more important localities are Chinaman's Creek (Note 6, QS. 14 SE), Woodbrook Road, Maldon Road, Yapeen, and Guildford in the Castlemaine area: along Upper Jackson's Creek, and North and South of Macedon railway station in the Gisborne district.

The type specimens are in the National Museum, Melbourne, and were collected by the Geological Survey of Victoria, at Ba 91, Guildford. The small excavation from which they were obtained is still visible though half a century has elapsed since it was made. I desire to thank the Museum authorities for permission to describe the specimens, which, on account of their origin, are of greater value than the numerous examples in my own collection.

CARDIOGRAPTUS, Harris and Keble.

The type of this genus is *Cardiograptus morsus*, figured by Harris and Keble.⁹

Description.—Rhabdosome lanceolate, the distal end deeply emarginate. Thecae long, of the type of *Didymograptus caduceus*, narrow, expanding, and slightly curved. In all respects except

9.—Harris, W. J., and Keble, R. A., Proc. Roy. Soc. Vict., 1916, vol. xxix. (n.s.), part 1, pl. 1, figs. 1-3.

shape the genus resembles *Oncograptus*, T. S. Hall, with which it is associated in the field.

Remarks.—Like *Oncograptus*, *Cardiograptus* appears to be a derivative from *Didymograptus caduceus*, Salter. It is easily distinguished from all other graptolites by its shape. It differs from *Oncograptus* in that

1. The whole rhabdosome is biserial. Examination of scores of specimens has failed to reveal one with uniserial stipes.
2. The outer margins of the rhabdosome are convex.

CARDIOGRAPTUS MORSUS, Harris and Keble,

1916, *Cardiograptus morsus*, Harris and Keble, Proc. Roy. Soc. Vict., Vol. XXIX., (n.s.), part 1, pl. 1, figs. 1-4.

Description.—Rhabdosome lanceolate, distal end deeply emarginate. Length from apex to base of emargination, 18-24 mm. The rhabdosome expands gradually to its maximum width, and then contracts slightly. Thecae 9-11 in 10mm. At the proximal end they are almost parallel to the axis, but soon turn through an angle of over 90° and towards the distal end have turned so much further that they make an angle of 320-340° with the axis. They are of the *Didymograptus caduceus* type, and are in contact for almost their whole length. The aperture is trumpet-shaped, with a long recurved denticle. The sicula is large—2mm. long and .5mm. broad.

Remarks.—The first theca seems to originate sub-orally, and the first thecae grow almost parallel with the sicula and project beyond its aperture. The thecae then turn through an angle as described above so that the sicula becomes embedded in the rhabdosome and is rarely, if ever, visible in mature specimens. Young forms bear a close resemblance to *D. caduceus*, var. *nanus*, Ruedemann var.¹⁰, and it seems as if the tendency which, in America, produced this variety, in Australia was even more pronounced, giving rise to this new genus. In a previous paper¹¹ a note suggested the possibility of *C. morsus* being a four-branched form like *Phyllograptus*. It seems desirable now to cancel this suggestion, as further work has failed to confirm it. The establishment of new genera for *Oncograptus* and *Cardiograptus* is necessary under the present system of graptolite nomenclature, for though the line of descent of both forms through *D. caduceus* seems clear, confusion would be caused by grouping all as *Didymograpti*.

Horizon and Localities.—*Cardiograptus morsus* is an important zonal graptolite of the Middle Darriwil. It occurs with *Oncograptus*, but not in the lowest beds in which *Oncograptus* is found. It then survives *Oncograptus*, but is not found in the highest Darriwil

10.—Ruedemann, R., Grap., N.Y., 1904, part 1, p. 698, fig. 90.

11.—Harris, W. J., Proc. Roy. Soc. Vict., 1916, vol. xxix. (n.s.), part 1, p. 66, note.

zone. Its associates include *Oncograptus epsilon*, *O. bi-angulatus*, *Didymograptus caduceus*, *D. forcipiformis*, *Phyllograptus* sp., *Trigonograptus ensiformis*, *Diplograptus*, spp., and *Glossograptus*.

It is common at most Middle Darriwil localities, such as Chinaman's Creek (Note 6, QS. 15 NW.), Yapeen, Guildford, Macedon, Woodend, Ingliston, Gisborne, and Darriwil.

ONCOGRAPTUS BI-ANGULATUS, Harris and Keble.

1916, Harris and Keble, Proc. Roy. Soc. Vict., Vol. XXIX., (n.s.), part 1, pl. 1, figs. 7-9.

Description.—Uniserial portion about 8mm. long. Breadth at level of bifurcation 8mm., width of uniserial branch about 3mm., length of branch 2cms. or more, branches diverging at an angle of about 30°. Thecae about 10 in 10mm., at first growing downwards in the direction of the sicular aperture, and projecting beyond it. Successive thecae then gradually turn until they are inclined at 310-320° to axis of stipe, this angle then being maintained. Apertures trumpet-shaped, of the character of *Didymograptus caduceus*, with a long recurved denticle.

Remarks.—This species differs from *Oncograptus epsilon*, T. S. Hall, in being narrower and in having longer uniserial branches. Both *Oncograptus epsilon* and *O. bi-angulatus* resemble in shape blunted arrow heads, but while *O. epsilon* would form an arrow with external surfaces inclined at 50° to each other, the angle in the case of *O. bi-angulatus* is only about half this.

Horizon and Localities.—The writer has not found this form in association with *Oncograptus epsilon*. It is common with *Cardiograptus morsus* at Chinaman's Creek, Castlemaine (Note 6, QS 15 NW.), in middle Darriwil beds, and is also found in Allot. 9 of Sec. 7, east of the Guildford-Daylesford Road (QS 15 SE.).

DIPLOGRAPTUS GNOMONICUS, Harris and Keble.

1916, Harris and Keble, Proc. Roy. Soc. Vict., Vol. XXIX., (n.s.), part 1, pl. 1, figs. 5, 6.

Description.—Rhabdosome invariably minute, less than 10mm. in length and with a maximum breadth of 2mm., doubly convex, with indefinite margins owing to the tenuity of the test. Thecae closely arranged, at first growing in the direction of the sicular aperture and then gradually turning through an angle of more than 90°. Virgula long, and usually conspicuous.

Remarks.—It is difficult to draw up an adequate description owing to the extreme tenuity of the whole form. It is usually preserved as a thin film surrounding the well marked virgula and inter-thecal walls, which stand out as fine but firm lines in the central portions of the rhabdosome. The film then fades off into the surrounding shale without showing details of the apertural portions of the thecae.

The species is named from the gradual reversal of the direction of the thecae.

Horizon and Localities.—*Diplograptus gnomonicus* is typical of the middle and upper Darriwil beds, and is found with *Didymograptus v-deflexus*, *Trigonograptus ensiformis*, *Oncograptus*, *Cardiograptus morsus*, and *Didymograptus caduceus* at outcrops where the matrix is favorable for the detection of such a form as, for example, in both road and railway cuttings between Guildford and Strangways; at Chinaman's Creek; and at, or near, Ba 91, south of Guildford (QS 15 SE.).

TRIGONAGRAPTUS ENSIFORMIS, J. Hall, sp.

- 1865, *Retiolites ensiformis*, J. Hall, Geol. Surv. Can., dec. 2, p. 114, pl. 14, figs. 1-5.
 1904, *Trigonograptus ensiformis*, Ruedemann, Grap. N.Y., pt. 1, p. 727, pl. 17, figs. 1-9.
 1908 *Trigonograptus ensiformis*, Elles and Wood, Brit. Grap., pt. 7, p. 302, pl. XXXV., figs. 1, a-c.

(For further references vide Ruedemann, sup. cit.)

Description.—Rhabdosome long, lanceolate, reaching its maximum width of 5mm. or more about 2cms. from the sicular end, and converging similarly at the distal end. Greatest length unknown. Margins usually perfectly linear and unbroken. Thecae indicated by the thick intertheecal walls, slightly alternate, in contact throughout their whole length, 11 in 10mm. in the mature portions of the rhabdosome but more closely arranged near the sicula, forming an angle of 45° with the axis of the rhabdosome. In most specimens a straight stout virgula is visible even when other details of structure are absent.

Remarks.—Our specimens agree in all respects with those described from Great Britain¹² and America¹³. The thecae are rather more closely arranged than those of American specimens but agree with English measurements. Strange to say, this *Trigonograptus* is quite distinct from the only previously described Australian species, *T. wilkinsoni*, T. S. Hall¹⁴, which has thecae inclined at 30°, 6½ in 10mm., oppositely arranged, and which is only 3mm. or less in width.

Localities and Horizon.—A typical graptolite of the Darriwil series, though, as yet, not recorded from Darriwil itself, where its place seems to be taken by *Trigonograptus wilkinsoni*. It is found at most other outcrops of the Darriwil beds, as, for example, Chinaman's Creek (Muckleford); near the N.W. boundary of the borough of Castlemaine; and at Guildford, Woodend, Macedon, and Gisborne.

12.—Elles and Wood, Brit. Grap., pt. 7, 1908, p. 302, pl. xxxv.

13.—Ruedemann, Grap., N.Y., pt. 1, 1904, p. 727, pl. xvii.

14.—Hall, T. S., Geol. Mag., 1899, dec. iv., vol. vi. (n.s.), p. 450-1, fig. 13.

LASIOGRAPTUS (THYSANOGRAPTUS) etheridgei, sp. nov.

(Plate VII., Figs. 3-7.)

1874, *Diptograptus mucronatus*, Etheridge, Junr., Ann. Mag. Nat. Hist., Sec. 4, Vol. 14, pl. 3, figs. 16, 17.1874, non *Diptograptus mucronatus*, McCoy, Prod. Pal. Vict., dec. 1, p. 10, pl. 1, figs. 5, 5a.

Description.—Rhabdosome about 2cms. in length and 4mm. in width (exclusive of the external meshwork), rapidly attaining its full width, which is then fairly well maintained though there is a slight narrowing towards the distal extremity. Thecae 9-11 in 10mm., apparently alternate, though this point is difficult to determine with certainty. Network delicate, yet impressed into the shale in such a way as to prove that the main threads, at any rate, were fairly substantial. The marginal network is usually well preserved, but is often missing from the distal portion of the rhabdosome, suggesting that it was not formed till a certain degree of maturity was reached by the thecae. Apertural margins of thecae apparently normal to the axis of the rhabdosome, virgular tube stout and often continued beyond the extremity of the rhabdosome.

Remarks.—After nearly half a century from the date of its first mention by Etheridge, an attempt is made to fix the identity of this distinctive graptolite. Etheridge¹⁵ included it among the first Victorian graptolites described, identifying it with the *Graptolithus mucronatus*, of J. Hall. This latter form has since been described by Elles and Wood¹⁶ as *Lasiograptus (Hallograptus) mucronatus*, a graptolite which seems distinct from our Victorian species. *Lasiograptus mucronatus* is described as characteristically lax, and the figures (Pl. XXXIII) show that there is no well-developed meshwork in the English specimens. Ruedemann's figures also¹⁷ show a *Lasiograptus mucronatus* distinct from ours. Referring to Etheridge's figures Dr. Ruedemann says¹⁸: "The form from the shales at Newham, near Lancefield, in Victoria, which has been identified by Etheridge with our species, is associated with species of the Deepkill zones or Point Levis shales, and represents a *Retiograptus*, closely related to *R. tentaculatus*, J. Hall. Neither can the Australian form identified by McCoy with this species have been properly placed." We do not agree with the identification with *Retiograptus*. McCoy's *D. mucronatus* in Victoria is a *Glossograptus* which we elsewhere identify with *Glossograptus hincksii*, and is from a higher horizon. Etheridge's *D. mucronatus*, figs. 16, 17, are of *Lasiograptus*. His figures 14, 15, from the Watchbox Ranges, Baynton, are *Glossograpti*.

15.—Etheridge, R., Junr., Ann. Mag. Nat. Hist., 1874, ser. 4, vol. 14, pl. 3, figs. 16, 17.

16.—Elles and Wood, Brit. Grap., 1908, part 7, p. 321.

17.—Ruedemann, Grap., N.Y., 1908, part 2, p. 480, figs. 456, 457; and pl. 29, 30, 31.

The specimen of *Lasiograptus etheridgei* figured in fig. 6 is from B 29 (QS 5 SW), Sec. 20, Newham, Etheridge's original locality and almost certainly from the same outcrop, which is of very limited extent. The present writer¹⁹, in an earlier paper, referred to this locality, and to the confusion its apparently mixed fauna has caused. The only further comment necessary here is to state that Dr. Hall's opinion²⁰ that this Newham locality is an outcrop of the *Tetragraptus* zone has not been substantiated by further investigation, nor does there seem any strong ground for the more recent opinion that both Darriwil and Castlemaine horizons are represented²¹. *Diplograptus* and *Lasiograptus* are inconsistent with a position in the Bendigo series, and *Phyllograptus*, which was originally held to have become extinct in the middle Castlemainian, has been found to range well into the Darriwil series. The form which Dr. Hall discussed and compared with *Goniograptus thureaui*²² is certainly not that species, and, while it may not be *Loganograptus loganii*, it seems to be a related form.

Figures 3-5 are from a small roadside cutting between Secs. 95 and 98, south of Old Racecourse Hill, Woodend. These forms are more robust than those from Newham, and have only 9 thecae per 10mm., as against 10 or 11 in the Newham specimens. In other respects they agree.

Associates and Horizon.—At B 29, Sec. 20, Newham, are found:

Didymograptus spp. (Mostly slender horizontal forms).

Didymograptus caduceus

Phyllograptus, sp.

Diplograptus, sp.

cf. *Loganograptus logani*

Climacograptus, sp.

Tetragraptus quadribrachiatas

Lasiograptus etheridgei

At the Woodend locality, *Phyllograptus* was not obtained, but we have the other forms mentioned, together with *Cryptograptus* and (?) *Cardiograptus morsus*.

Both beds are in the upper zones of the Darriwil series, possibly near the summit of the Lower Ordovician. Etheridge, as we have already seen, records the form from the Watchbox Ranges, Baynton.

RETIOGRAPTUS SPECIOSUS, SP. NOV.

(Plate VIII., Figs. 8-10.)

Description.—Rhabdosome small, usually less than 10mm. in length, and widening rapidly to a width of 3mm., which is then maintained or perhaps slightly exceeded. Test perhaps originally con-

18.—Ruedemann, Op. Cit., p. 481.

19.—Harris, Proc. Roy. Soc. Viet., 1916, vol. xxix. (n.s.), part 1, p. 65.

20.—Hall, T. S., Proc. Roy. Soc. Viet., 1895, vol. vii. (n.s.), p. 73.

21.—Skeats and Summers, Bull. Geol. Surv. Viet., No. 24, 1912, p. 41.

22.—Hall, T. S., Prog. Rpt.^s IX., Geol. Surv. Viet., 1898, p. 126.

tinuous, but greatly attenuated so that in juvenile specimens and towards the distal end of mature specimens the lists which supported it are alone visible. Both sides, or rather the front and rear of the rhabdosome contain medial zigzag, ascending axes. Thecae, 14 in 10mm. Sacula not observed with certainty, and probably minute.

Remarks.—This form is quite unlike any other with which we are acquainted, though, when preserved so that the two ascending zigzags coincide, the outline agrees with that sometimes shown by *Retiograptus geinitzianus*, Hall. Its characteristic outline, however, is quite different, and so is the arrangement of parietal lists. These arise from the zigzag medial of each surface, at the apices of the zigzags. Their direction, especially near the proximal end of the rhabdosome, is at first almost horizontal, but they gradually ascend and form part of what may be called the ventral strands. The thecae appear to have been sub-rectangular in section in the body of the rhabdosome and the same shape is maintained throughout, though the axis of each theca is curved upwards, and the theca gradually narrows towards its aperture. The thecae seem to have been provided with a small mucro at each lower angle of the aperture. The test, as has been stated, is attenuated. In young specimens only the meshwork which supported it is preserved, while the typical specimens show the test covering all the rhabdosome except the distal portion, but so thinly that the lists show through it. Some specimens show a continuous test.

Localities and Horizon.—Common in the bluish shales at the junction of Riddell's and Jackson's Creeks, south of Riddell (Ba 67, QS 6 SE). As mentioned in an earlier paper, this locality is erroneously marked on the Quartersheets as Ba 68. The horizon is Upper Ordovician. From the presence of *Didymograpti* (including very rarely *Didymograptus caduceus*), and the absence of the *Dicranograptidae*, we conclude that these beds are among the lowest of the Upper Ordovician. This position is supported by the very common occurrence of *Glossograptus* and *Cryptograptus*, which both pass up from the Lower Ordovician.

CLIMACOGRAPTUS RIDDELLENSIS, sp. nov.

(Plate VIII., Figs. 11, 12.))

1874, *Diplograptus, rectangularis*, McCoy, Prod. Pal. Vict., dec 1, pl. 1, fig. 7, 7a.

Description.—Rhabdosome in typical specimens about 3cms. in length, about .7mm. wide at proximal end, widening very gradually to an average breadth of 1.4 to 1.7 mm. This breadth is attained about 1 cm. from the sicula. The distal width may be slightly less. Virgella conspicuous but short (1 to 1.5mm.). The basal thecae are provided with small spines. Thecae 10-11, less rarely as many as 13 in 10mm., overlapping about one-third of their length, free outer edges straight and vertical, apertural margins horizontal. Excavations semi-

circular, occupying more than one-third of the width of the rhabdosome. Virgula often visible within the body of the rhabdosome, and prolonged beyond the distal end. The rhabdosomes with the more closely arranged thecae are usually slightly narrower than the typical form. The characters are remarkably constant in the great number of specimens examined.

Remarks.—*Climacograptus riddellensis* seems to be most closely allied to *C. antiquus*, Lapworth²³. *C. antiquus*, is, however, broader, and the thecal indentations are shallower, relatively broader, and less curved. *C. antiquus* in England is commonest in the zone of *Nemagraptus gracilis*. In this zone, the Didymograptidae make their last appearance with *Didymograptus serratulus* and *D. superstes*, while the Leptograptidae and Dicranograptidae first appear. Glosso-graptus (including *G. hincksii*), *Diplograptus*, *Retiograptus* and *Lasiograptus* also occur. *Cryptograptus tricornis* is for the first time common²⁴.

The association at Jackson's Creek is what might be expected if *C. riddellensis* were to be regarded as the Australian representative of *C. antiquus*. We find *Retiograptus* (represented by the new *Retiog. speciosus*), *Cryptograptus tricornis* (very abundant), *Glossograptus hincksii*, *Diplograptus*, and some surviving Didymograptidae, including, very rarely, *Didymograptus caduceus*, the range of which in Victoria is not the same as has been worked out in England. One difference of association may be noticed: the Dicranograptidae and Leptograptidae are in Victoria seemingly representative of a higher horizon than in England and are not represented in the present collection. A careful comparison with figures of the type of McCoy's English *D. rectangularis*²⁵, shows that the two species are distinct. *D. (Climacograptus) rectangularis* is, moreover, a Silurian form²⁶.

McCoy's record²⁷ of *Diplograptus mucronatus* from Ba 67 is therefore erroneous if, as seems to be the case, this is the graptolite he was describing. (See particularly McCoy's fig 7a.)

GLOSSOGRAPTUS HINCKSI, Hopkinson, sp.

(Plate VIII., Figs. 13-16.)

- 1872, *Diplograptus hincksii*, Hopkinson, Geol. Mag., vol. IX., p. 507, pl. XII., fig. 9.
 1874, *Diplograptus mucronatus*, McCoy, Prod. Pal. Vict., dec. 1, p. 10, pl. 1, figs. 5, 5a.
 1908, *Glossograptus hincksii*, Elles and Wood, Brit. Grap., pt. VII., p. 309, pl. XXXIII., figs. 2, a-j.

Description.—Rhabdosome rarely exceeding 3cms. in length, the usual length being about 2cms.; base rounded, widening rapidly to

23.—Elles, G. L., and Wood, F. M. R., Brit. Grapt., 1906, part v., p. 199, pl. xxvii., fig. 4 a-c.

24.—Ibid., 1914, part x., p. 521.

25.—Elles and Wood, op. cit., 1906, part v., p. 187, pl. xxvi., figs. 5 a-c.

26.—Ibid., 1914, part x., p. 519.

27.—McCoy, F., Prod. Pal. Vict., 1874, dec. 1, p. 11, pl. 1, figs. 7, 7a.

a maximum breadth of 2mm, which is then maintained. This applies to the bi-profile view—in the scalariform aspect the width is often slightly greater. Sicular obscure, apertural spines of sicular and of proximal thecae directed vertically downward. Virgular tube usually long and conspicuous. Thecae 11-12 in 10mm., overlapping rather less than half their length, apertural margins straight or but slightly everted, apertural spines strong, somewhat arcuate, nearly as long as width of rhabdosome, septal spines straight, spur-like, ascending.

Remarks.—The description above, drawn up from Jackson's Creek specimens, practically agrees with that given by Elles and Wood²⁸. The English authors give the thecae as 16-10 in 10mm. Our specimens from the locality mentioned show greater constancy in spacing. In the scalariform view our forms also show a more spinous proximal portion than any of the English figured specimens, which leave this point rather obscure. The appearance shown by the specimens figured in figs. 14, 15 is characteristic.

McCoy²⁹ in 1874 figured this graptolite from the same locality as *Diplograptus mucronatus* — fig 5, natural size, being readily recognised as our species though the drawing is somewhat conventionalised. Dr. Ruedemann³⁰ has already pointed out that McCoy's and Etheridge's identifications were erroneous.

Horizon.—"Very abundant, and beautifully preserved in the white decomposed soft shale, Ba 67" (McCoy, p. 10). Ba 67 is at the junction of Riddell's and Jackson's Creeks, about three miles south-east of Riddell railway station on the Melbourne-Bendigo railway. The horizon is Upper Ordovician, but low in the series.

DIDYMOGRAPTUS (ISOGRAPTUS) CADUCEUS Salter.

(Plate VIII., 17 and 18.)

- 1853, *Didymograptus caduceus*, Salter (pars), Q.J. Geol. Soc., Vol. IX., p. 87, fig. 1a.
 1874, *Tetragraptus bryonoides*, J. Hall (D. caduceus, Salter), Etheridge junr., Ann. Mag. Nat. Hist., ser. 4, pl. 3, figs. 3, 4.
 1875, *Graptolites (Didymograpsus) caduceus*, McCoy, Prod. Pal. Vict., dec. 2, p. 30, pl. XX., figs. 3-5.
 1901, *Didymograptus (Isograptus) gibberulus*, Elles and Wood, Brit. Grap., part 1, p. 52, pl. II., figs. 9, a-e.
 1904, *Didymograptus (Isograptus) caduceus*, Ruedemann, Grap. N.Y., part 1, p. 693, pl. XV., figs. 6, 7.

Twenty-five years ago, Dr. T. S. Hall said³¹, speaking of *D. caduceus*, "It is interesting to notice, as we pass up through a long series of rocks above those of Bendigo, that it increases

28.—Elles and Wood, 1908, supra.

29.—McCoy, 1874, supra.

30.—Ruedemann, 1908, Grap. N.Y., part 2, p. 481.

in relative numbers and at the same time gradually attains a much larger size till it reaches its maximum near the horizon of the uppermost Castlemaine beds, where it crowds the rocks to the almost entire exclusion of other forms. It then enters on the period of its decline, is but sparingly represented by stunted forms at Darriwil, and perhaps ranges up into the Upper Ordovician." The writer is not aware of the evidence on which Dr Hall based this last presumption, although two facts may have influenced him. Firstly, *D. caduceus* is recorded from Guttamurrh Creek³², a tributary of the Snowy River in eastern Gippsland, in an area regarded as Upper Ordovician, and, secondly, the occurrence, also in Gippsland, of a form somewhat like *D. caduceus* in external form and described by Dr. Hall later as *Didymograptus ovatus*³⁴. We have been unable to gather any further information about the Guttamurrh Creek graptolites, while *D. ovatus* seems quite distinct from *D. caduceus*. However, it is now possible to figure *D. caduceus* from the Upper Ordovician of Ba 67, at the junction of Jackson's and Riddell's Creeks (QS 6 SE). Shale amounting to more than a ton had been searched before the first specimen came to light, so that it may be regarded as extremely rare on this horizon, which, from other considerations, we had already placed in the lower portion of the Upper Ordovician. The description of the specimen is given hereunder.

Description.—Stipes short, decreasing in width from the common point of origin where they are 2mm. wide over all, and forming a rhabdosome of a horse-shoe shape. Sricula long and slender. Thecae 6 in 10mm., curved, inclined to the axis at 30-40°, about four times as long as wide, in contact throughout their length. Apertural margins concave, angle obtuse.

Remarks.—It is remarkable that this description is almost identical with that given by Elles and Wood for the British lower Ordovician *D. caduceus* (*gibberulus*³³), while it would be inaccurate for the species at the period of its maximum development at Castlemaine. Though *D. ovatus* has somewhat the same general appearance as some specimens of *D. caduceus*, its resemblance to the present specimen, even externally, is very slight, and when a detailed examination is made its distinctness is very evident, as will be shown by the following description of *D. ovatus*³⁴: "Hydrosome stout, branches abruptly recurved and gradually approaching one another so that the polypary resembles in outline an imperfect specimen of *P. typus*. Thecae 12 in 10 mm., closely allied to *D. caduceus*, from which it differs in aperture of thecae and reflection of branches."

The specimens of *D. caduceus* represented in figs. 17, 18 are now in the National Museum, Melbourne.

31.—Hall, T. S., Geol. mag. (n.s.), Dec. iv., vol. vi., 1899, p. 443.

32.—Prog. Report, Geol. Surv. Vict., No. 111, 1876, p. 186 (note).

33.—Elles and Wood, Brit. Grap., part 1, 1901, p. 52.

34.—Rec. Geol. Surv. Vict., 1902, vol. i., part 1, p. 33.

THAMNOGRAPTUS CAPILLARIS, Emmons, sp.

1885, *Nemagraptus capillaris*, Emmons, Amer. Geol. v. 1, pt. II., p. 109, pl. 1, fig. 6.

1893, non *Thamnograptus typus*, T. S. Hall, Austr. Assn. Adv. Sci.

1908, *Thamnograptus capillaris*, Ruedemann, Grap. New York, part 2, p. 208, fig. 110 (copied from J. Hall, Pal. N.Y., 1859:3:519, fig. 22).

Description.—Only fragments of the rhabdosome have as yet been found. These consist of a straight or slightly zigzagged main stipe, from which secondary branches are given off on alternate sides, directed horizontally, at intervals of from 2 to 3mm. The main stipes that we have seen are less than 1mm. in width and the secondary branches are often hair lines. The longest fragment observed was apparently only the distal portion of a main stipe and was about 15cms. long. The material is too poorly preserved to enable any observations of thecae to be made, nor have we any evidence of the further branching of the secondary branches.

Remarks.—No drawings have been made as the material is too poorly preserved to show details of structure. The general appearance of the form may be gathered from J. Hall's original figure of *Thamnograptus typus*³⁵. The Victorian form is not so coarse as the specimen there figured.

A certain amount of mystery has always surrounded the genus *Thamnograptus*, and this is not lessened by the occurrence in the Bendigo and Lower Castlemaine zones of forms externally resembling *Thamnograptus*. Dr. T. S. Hall³⁶, after referring them to *Thamnograptus*, finally, and with considerable hesitation, placed them in the genus *Goniograptus* as *G. crinitus*, and figured thecae observed on one of the finer branches. He remarked, however, that he had never found specimens with the typical *Goniograptus* aspect, i.e., with four main stipes. The writer has had the same experience and has, moreover, failed to find thecae on any specimens of *Goniograptus crinitus* which have come under his observation. The presence of thecae as figured by Dr. Hall is decisive enough to exclude *G. crinitus* from the genus *Thamnograptus*.

In 1919, the writer found fragments near Digger's Rest (Ba 62, QS 7 SE) and also at Gisborne. These fragments would have been referred to *Goniograptus crinitus* had their horizon been lower, but the Digger's Rest locality is Upper Ordovician, with *Dicranograptidae*, etc., while the Gisborne outcrop seems to represent one of the highest beds of the Lower Ordovician since *Tetragraptus*, *Diplograptus*, *Cryptograptus*, and *Trigonograptus* are found

It seems, therefore, preferable to record the present forms as *Thamnograptus capillaris*, and to leave the relationship with

35.—Ruedemann, R., Grap. N.Y., 1908, pt. 2, p. 208, fig. 110.

36.—Hall, T. S., Proc. Roy. Soc. Vict., 1914, vol. xxvii. (n.s.), pt. 1, p. 111.

Goniograptus crinitus (if any) for future investigation. The record of *Thamnograptus capillaris* is, therefore, strictly speaking, new for Victoria.

Localities.—Ba 62 (near Digger's Rest); Jackson's Creek, north of Gisborne township.

EXPLANATION OF PLATES.

PLATE VII.

- Fig. 1.—*Didymograptus v-deflexus*, sp. nov. Holotype. East of Guildford-Daylesford Road, Ba 91, Allot, 9, sect. 7. Q.S. 15 S.E. Coll. Geol. Surv. Viet.
 „ 2.—*Didymograptus v-deflexus*, sp. nov. Paratype. Same locality.
 „ 3.—*Lasiograptus (Thysanograptus) etheridgei*, sp. nov. Holotype. Sects. 95, 98, Woodend. Coll. W. J. Harris; pres. Nat. Mus. Coll.
 „ 4, 5.—*Lasiograptus (Thysanograptus) etheridgei*, sp. nov. Paratypes. Same locality. Coll. W. J. Harris; pres. Nat. Mus. Coll.
 „ 6.—*Lasiograptus (Thysanograptus) etheridgei* sp. nov. Paratype. Newham. Ba 29, sect. 20. Coll. by W. J. Harris; pres. Nat. Mus. Coll.
 „ 7.—*Lasiograptus (Thysanograptus) etheridgei*, sp. nov. Paratype. Sect. 95. Woodend. Coll. W. J. Harris; pres. Nat. Mus. coll.

PLATE VIII.

- „ 8.—*Retiograptus speciosus*, sp. nov. Holotype. Junction of Jackson and Riddell's Creeks. Ba 67. Coll. W. J. Harris; pres. Nat. Mus. coll.
 „ 9.—*Retiograptus speciosus*, sp. nov. Paratype. Side view. Same locality. Coll. W. J. Harris; pres. Nat. Mus. coll. $\times 1\frac{1}{2}$.
 „ 10.—*Retiograptus speciosus*, sp. nov. Paratype. Juvenile stage. Periderm almost absent. Same locality. Coll. W. J. Harris; pres. Nat. Mus. coll. Nat. size.
 „ 11.—*Climacograptus riddellensis*, sp. nov. Holotype. Same locality. Coll. W. J. Harris; pres. Nat. Mus. coll. (K1).
 „ 12.—*Climacograptus riddellensis*, sp. nov. Paratype. Same locality. Coll. W. J. Harris; pres. Nat. Mus. coll. (K2).
 „ 13.—*Glossograptus hincksii*, Hopkinson sp. Juvenile form. Same locality. Coll. W. J. Harris; pres. Nat. Mus. coll. (Z1)
 „ 14.—*Glossograptus hincksii*, Hopkinson sp. Same locality. Coll. W. J. Harris; pres. Nat. Mus. coll. (Y1)
 „ 15.—*Glossograptus hincksii*, Hopkinson sp. Specimen showing sicular and septal spines. Scalariform aspect. Same locality. Coll. W. J. Harris; pres. Nat. Mus. coll. (Z2)

- „ 16.—*Glossograptus hincksii*, Hopkinson sp. Sub-scalariform aspect. Same locality. Coll. W. J. Harris; pres. Nat. Mus. coll. (Z3)
- „ 17.—*Didymograptus caduceus*, Salter. Upper Ordovician. Same locality. Coll. W. J. Harris; pres. Nat. Mus. coll.
- „ 18.—*Didymograptus caduceus*, Salter. Another example. (D1). Coll. W. J. Harris; pres. Nat. Mus. coll.